

AD-783 203

A SURVEY OF SELECTED BACTERIOLOGICAL
INFECTIONS OF THE CHACMA BABOON
'PAPIO URSINUS' FROM THE KRUGER
NATIONAL PARK

C. A. W. J. Van Niekerk, et al

Armed Forces Institute of Pathology
Washington, D. C.

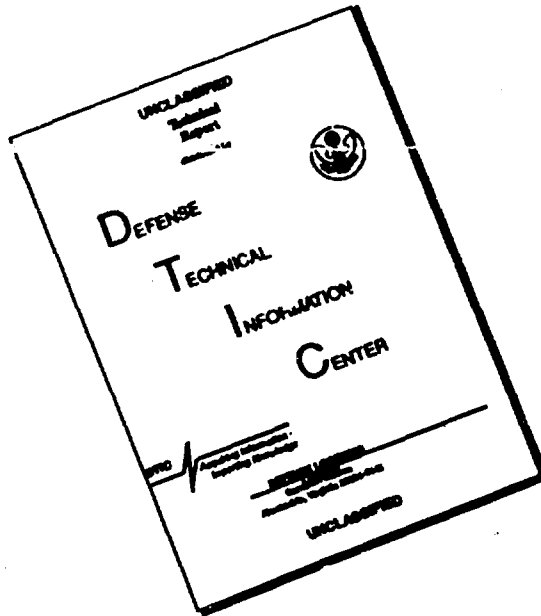
1973

DISTRIBUTED BY:

NTIS

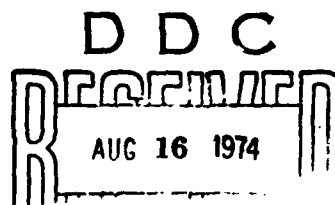
National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

DISCLAIMER NOTICE



**THIS DOCUMENT IS BEST
QUALITY AVAILABLE. THE COPY
FURNISHED TO DTIC CONTAINED
A SIGNIFICANT NUMBER OF
PAGES WHICH DO NOT
REPRODUCE LEGIBLY.**

Koedoe 16: 1-10 (1973).



AD783 203
A SURVEY OF SELECTED BACTERIOLOGICAL
INFECTIONS OF THE CHACMA BABOON
PAPIO URSINUS FROM THE
KRUGER NATIONAL PARK

by

V. DE VOS*,
C. A. W. J. VAN NIEKERK* and E. E. McCONNELL**

Abstract - An absence of bacterial pathogens and zoonoses emerged as the salient feature in a bacteriological survey of chacma baboons from the Kruger National Park. Totals varying from 100 to 178 baboons were assayed for salmonellosis, shigellosis, tuberculosis, brucellosis and leptospirosis. It is conjectured that with Kruger National Park baboons, the abovementioned pathogens are not expected to complicate handling procedures or experimentation, provided a clean or pathogen-free environment is maintained from the day of capture onwards.

Introduction

Within the rapidly expanding literature on primatology, the baboon (*Papio* spp.) has always featured prominently (Shilling, 1964). This interest has further expanded to include the world of medicine, where the use of *Papio* spp. as model in biomedical research has been generally acclaimed (Vagtborg, 1965). In South Africa this was borne out by successfully exploiting the large numbers of baboons which are found in certain areas of the Republic for experimental purposes. Research projects on surgery, serology, chemistry, pharmacology, neurology, radioisotopes and specific disease conditions such as nephrocalcinosis, arteriosclerosis and cancer have found ideal research material in the baboon (Baboons in Organ Transplantation, 1968; Groenewald, 1970; De Klerk, *pers. comm.*) and are steadily exerting an increasing demand on the free-living baboon reserves of the country. In this respect the Kruger National Park (K.N.P.) have contributed handsomely towards the demand in the Transvaal and have sacrificed 370 to biomedical research projects over the years 1969 to 1970 as part of a discriminative cropping scheme. These baboons were taken mainly from traps near the vicinity of rest camps and along tourist roads bordering riverine areas where excessively high numbers of baboons are

* Veterinary Investigation Centre, Kruger National Park, P.O. Box 12, Skukuza.

** Armed Forces Institute of Pathology, Washington D.C. and Veterinary Research Institute, Onderstepoort.

found and where the nuisance value of individuals is at times rated as very high. Each baboon, caught and used in experiments, was therefore credited with a history of contact or semi-contact with man by means of unauthorised feeding procedures by tourists or the free access to offal dumps near rest camps (Fig. 1).



Fig. 1. Semi-contact with man established by scavenging in the Kruger National Park.

Human contact and an essentially free-living nature, both centred in the K.N.P. baboon populations, suggest possibilities for the occurrence of anthroponoses but of an unknown quantity. It was therefore thought advisable to start an inquiry into their health, or potential disease carrier status. A study on the pathology of the baboon was therefore initiated during 1969 and terminated during the first quarter of 1972 (McConnell, Basson, De Vos, Myers and Kuntz, *in press*). For this study a total of 100 baboons from representative areas throughout the K.N.P. were used. As part of this study it was thought advisable to assess the bacteriological status of the baboons. However, referring to bacteriological aspects of renal allotransplantation or homotransplantation with baboons as experimental material, Brede and Murphy (1968) declared: "Distinction between infection and disease is of paramount interest to the transplant research worker. Bacteriological findings should be interpreted with great caution. The mere fact that a given microbe is cultured from a patient or from an experimental animal may be totally irrelevant. Only the combi-

nation of all physical signs and of all laboratory findings enables an integrated team of specialists to come to appropriate conclusions". After starting the bacteriological survey on an intensive and ambitious scale this argument was realized and the study procedure modified to include only the better-known pathogens, particularly those suspected of being zoonoses. This report documents the results and conclusions of this survey.

Material and Methods

The main part of the study was conducted between October 1969 and October 1971 on 100 baboons collected from the K.N.P. Two methods were employed for obtaining animals: A trap capturing method and a field drug immobilization procedure (projectile dart-syringe method).

The traps were set up only in areas known to be frequented by baboons, like offal dumps from the rest camps and along riverine tourist roads. Drug immobilization techniques were attempted along roads which are heavily utilized by tourist traffic. Fruit and bread-crumbs were used to entice the baboons towards the vehicle from which the darting was attempted. This method not only assured the selective removal of "beggars" from the community but greatly increased the probability of using baboons with previous histories of semi-contact with humans. The dart syringe was propelled by means of the "cap chur" pistol (Palmer), which was mostly camouflaged by a paper bag, therefore simulating a bag of "goodies" to the beggar baboons. Immobilization was effected by the use of Sernylan (phenacyclidine hydrochloride, "Parke-Davis and Company"), the subjects retrieved and then taken directly to Skukuza where they were kept for a period not exceeding five days prior to the commencement of necropsy procedures. During this period they were kept in separate cages and fed mealie porridge, offal fruit and vegetables from the Skukuza rest camp restaurant. The baboons from the capture cages were also sedated with Sernylan in order to facilitate handling.

While still recumbent a razor blade was used to remove the hair from a three cm square patch of skin on the forearm of the individual and 500 International Units of tuberculin (Onderstepoort manufactured) were injected intradermally. In addition 3 500 I.U. of tuberculin were injected into the upper eyelid. Animals were kept under observation for three days for signs of a reaction, such as swelling and hyperaemia.

On the day of examination the subject was again sedated, weighed and a throat swab taken before it was killed by exsanguination. Due to complications (see below) the swab-taking procedure was discontinued after 10 baboons were done. As soon as death intervened, a very thorough and meticulously applied necropsy procedure was performed in each case. Relevant data and material were collected routinely as part of the survey. Directly on opening the gut, scrapings (approximately 2 g) from the wall of the small intestine (proximal one fourth) and its contents, were suspended in selenite enrichment medium (Oxoid). After 6 hours incu-

bation at 37°C a loopfull was plated on MacConkey agar, brilliant green agar, desoxycholate agar and Salmonella-Shigella (SS) agar plates (Oxoid). All plates were examined after 24 hours of incubation at 37°C and non-lactose fermenting colonies resembling *Salmonella* spp. and *Shigella* spp. were selected, and transferred to triple sugar iron agar (TSI) slants (Oxoid). Organisms giving positive and suspicious reactions (Bailey and Scott, 1966) were tested for motility and examined by the slide agglutination test with group specific *Salmonella* typing sera (Onderstepoort manufactured). Organisms reacting with the antisera and non-motile organisms were subsequently assayed for indol, methyl red, Voges Proskauer and citrate (IMViC) reactions (Bailey and Scott, 1966) and tested on carbohydrate media (dextrose, maltose, dulcitol, lactose, sucrose, inositol, salicin, trehalose, rhamnose, mannite, mannose). Isolates giving typical reactions were forwarded for serotyping to the Veterinary Research Institute at Onderstepoort, Pretoria, Transvaal.

In addition to material from the small intestine, rectal swabs were taken from 20 baboons and treated in basically the same way.

During exsanguination blood was collected, the serum harvested and tested for *Brucella* and *Leptospira* antibodies. The standard agglutination tests as outlined by the Joint FAO/WHO Expert Committee on Brucellosis (1964) was used for the detection of *Brucella* antibodies. Standard *Brucella abortus* antigen (Onderstepoort manufactured) was used. In addition to the 100 samples forming the main body of the study, this survey was supplemented by 78 incidental collections from the vicinities of the Skukuza and Lower Sabie rest camps. Sera were examined for leptospiral antibodies, employing the agglutination-lysis test, based on the standard procedure used in laboratories throughout the world (Wolff, 1954) and which is considered a reference test (Roth, 1971). Five serotypes were used viz. *Leptospira icterohaemorrhagiae*, *L. canicola*, *L. pomona*, *L. hyos* and *L. bratislava*. A total of 130 serum samples was tested, consisting of 85 from the main body of study and 45 incidental collections from the vicinities of the Skukuza and Lower Sabie rest camps.

Results

An analysis by age and sex of the baboons that were incorporated in the main study, are provided by Table 1.

The throat swab material invariably caused overgrowth of the media by *Proteus* or fungus spp. However, in spite of overgrowth, a variety of at least four different, but unidentified, organisms (colony morphology) were counted each time.

No *Shigellae* sp. was isolated and only one *Salmonella* sp. was found, which was subsequently identified by the Veterinary Research Institute at Onderstepoort as belonging to the non-pathogenic soil group of Salmonellae. Further identification was not attempted.

The tuberculin tests as well as the *Brucella* and *Leptospira* serological tests produced negative results in all cases.

Table 1
Age and sex of baboons that formed the main body of the study.

| Age Category * | Males | Females | Total |
|--|-------|---------|-------|
| Immature: ♂ - ♀ : 3,00 kg. | — | — | 8 |
| Adolescent: ♂ 3 — 12,99 kg. ♀ 3 — 10,99 kg. | 15 | 8 | 23 |
| Adult: ♂ > 12,99 kg. ♀ > 10,99 kg. | 43 | 36 | 69 |
| Total | — | — | 100 |

* Age groups were based on liveweight correlated with sexual maturity (spermatogenesis, ovaulation and evidence of past pregnancy) as determined by McConnell et al. (In press).

The complete negativness of the inquiry was borne out further, during necropsy procedures, by an inability to find any pathological lesion which was caused or complicated by a bacterial agent.

Discussion

General Bacteriology

Due to time limits posed by the comprehensiveness of the entire master study programme, the time could not be found to isolate and identify the multitude of species which apparently were associated with the mouth and throat environment. Swarming *Proteus* and overgrowth by fungi further complicated matters. This part of the study was, therefore, discontinued after 10 specimens were completed. However, in light of findings by Brede and Murphy (1968) to the effect that baboons from the Western Cape area exhibit an astonishing 54,1 per cent incidence of *Staphylococcus aureus* organisms in the mouth cavity, future inquiry into this aspect is indicated for the K.N.P.

Enteric Pathogens

Amongst non-human primates the trend of the literature seems to suggest a common incidence of enteric bacterial pathogens in newly imported as well as laboratory-conditioned primates (Schneider, Prather, Lewis, Scatterday and Hardy, 1960; Carpenter and Cooke, 1965; Good, May and Kawatomari, 1969), whilst their counterparts in the free-living state persistently failed to reveal the presence of enteric pathogens (Panda and Gupta, 1964; Carpenter and Cooke, 1965; Nath, Shirvastov, Sethi and Singh, 1966; Carpenter, 1968). Carpenter (1968) quotes surveys of wild primates from Tanganyika, Kenya, East Africa, Malaya and India which resulted in negative isolates from 827 animals examined.

In a bacteriological survey of 427 baboons (Brede and Murphy, 1968) from the Stellenbosch-Hopkins Project at Bellville, Cape Province, *Salmonella sunsvall* was isolated from 46 animals, not one of which showed signs of clinical disease. *Shigella flexneri* type IV was isolated from 12 baboons

and *Shigella flexneri* type II from one baboon. Tests were performed immediately prior to entry into the Karl Bremer colony. With the exception of five, all the animals were free-living before they joined the colony. From the article it is, however, impossible to gauge the time factor post capture and possibilities of infection during the transit phase.

The inability to isolate pathogenic *Salmonellae* or *Shigellae* in the present study still further endorses the negative trend in feral non-human primates as indicated by Carpenter (1968) and Fiennes, Pinkerton and Dzhibidze (1972). The source of infection, then, still remains unknown. In this respect one may then conjecture, partly with Good *et al.* (1968), that infection is perpetuated in holding compounds, or that non-human primates represent a uniquely susceptible host under close confinement or other stressful conditions. A dormant infection may also be brought forward under these conditions. Circumstantial evidence, however, seems to rule out the latter possibility as a complicating factor for K.N.P. baboons. This evidence was introduced through the fact that no signs of these infections were noted in 78 baboons from the K.N.P. which have so far been held in captivity by the Medical Research Council, C.S.I.R., Pretoria (De Klerk, *pers. comm.*). These baboons were at times subjected to rather stressful conditions brought about by various experiments, but were always kept under impeccably clean hygienic conditions. It can therefore be concluded that with K.N.P. baboons enteric pathogens are not expected to constitute a complicating factor during holding procedures or experimentation, provided a clean or enteric pathogen-free environment is maintained.

Tuberculosis

It has long been recognized that tuberculosis is a major killing disease of monkeys in captivity. In this respect Fiennes (1972) wrote: "Tuberculosis has been, and still is, the most dangerous and costly disease that can be imported into monkey houses, whether in zoos or in research establishments". These animals are susceptible to both human and bovine types and the rate of spread within a population is very rapid (Ruch, 1959; Rankin and McDiarmid, 1968). Remarking on this disease, Henning (1956), however, stated that as long as wild animals, which are susceptible to the disease, are kept under natural conditions in the open country, infection seldom occurs; but when they are detained in captivity they are liable to become infected. Nieberle (1932) and Urbain (1941) also reported on the absence of this disease in free-living primates.

The extremely low incidence of infection in feral non-human primates led Fiennes (1972) to believe that the source of infection usually lies in human contacts. These observations are further substantiated by the negative findings of the present study.

Brucellosis

The incidence of brucellosis in free-ranging non-human primates seems

to be extremely low. Only one case of natural brucellosis, proven by culture, has been reported in non-human primates (Pinkerton, 1967). The organism was recovered from a wild baboon which was sacrificed in Kenya and was tentatively identified as *Brucella melitensis*. In addition, serological studies have revealed only occasional positive agglutination tests resulting from studies of baboons era collected on African expeditions (Kalter, Kuntz, Al-Deory and Katzberg, 1967; Kalter, Kuntz, Myers, Eugster, Rodrigues, Benke and Kalter, 1968).

In the human, the *Brucella* serum agglutination test, when carried out with a suitable antigen and a satisfactory technique, nearly always gives significantly positive results in the presence of active infection (Joint FAO WHO Expert Committee on Brucellosis, 1964). However, in cases of low titres or negative reactions, repeated tests are advocated before regarding brucellosis as unlikely.

In wild animals in a free-living state, repeated tests are impracticable, and representative samples from the population have to be examined before arriving at a definite conclusion. Completely negative reactions from 160 baboons in the present study are therefore considered a significant indicator of the true position in the population. These results are further augmented by eight negative serological tests in a previous study on the incidence of brucellosis in the K.N.P. (De Vos and Van Niekerk, 1969).

Leptospirosis

As Wolff (1951) pointed out, it is impracticable to include all antigenic serotypes in all tests that are performed. The number and identities of serotypes may therefore vary, depending on the scope of any particular investigation and the variety of serotypes believed to exist in the locality (Proom, 1959). On this basis five serotypes were selected and employed in the test, and is therefore considered representative as a screening test for the determination of the incidence of leptospirosis in the K.N.P. baboon population. The negative reactions that were obtained are considered significant.

In accordance with these findings the literature (Van der Hoeden, 1964; Minette, 1966; Pinkerton, 1972) also suggests that there is apparently very little natural leptospirosis in non-human primates.

Ecological Considerations

Free ranging baboons are socially integrated into a system of troops (Stoltz and Saayman, 1970) with an intricate social behaviour pattern allowing ample opportunity for contact and semi-contact between individuals. The data on interaction between troops in overlapping home range areas, however, seems to be conflicting. Bolwig (1959) describes violent fighting when troops of chacma baboons meet, whilst Stoltz and Saayman (1970) observed no physical contact in the antagonistic behaviour pattern between two groups. Stoltz and Saayman (1970) also found no evidence that inter-change between troops takes place. One would

therefore expect that the sociable intratroup interactions would allow for a high degree of communicability of bacterial organisms within a group, whilst intertroup aggression would act as a limiting factor to the spread of disease to neighbouring groups.

A representative sample of the population would therefore necessarily call for the exploitation of as many groups as possible. For this survey samples were taken from at least 29 troops and distributed throughout the study area. The chief rainfall and distinct vegetational areas were represented in the final selection of the troops. Results obtained in the study can therefore be expected to reflect the true prevalence of the assayed disease conditions for the total population.

When not unduly disturbed, baboons do not live in fear of human proximity, and may even be attracted by human activity. Commenting on the preferred sleeping sites of a baboon troop, Stoltz and Saayman (1970) wrote: "Disturbance by humans seemed, however, to be of minor significance since the preferred sleeping site was situated where disturbance due to holiday-makers was most likely". In the K.N.P. the highest densities of baboons are most decidedly found along the tourist travelling routes and in the vicinity of human habitations. It must be stressed, however, that a high percentage of these roads is situated in the vicinity of watering points. This affinity to human dwellings is brought about mainly by the scavenging habits of the baboon. It is a habit which is quickly acquired, as is reflected by the promptness with which activity appears and assumes a habitual nature around temporary camping sites.

In the free-ranging state as found in the K.N.P., favourable circumstances are therefore created for a zoonotic nidus, with the likelihood of the chain of inter-species infections being directed towards the baboon. The literature and the results of this study are, however, in agreement that an exceptionally low incidence of bacterial zoonoses are found in free-ranging animals. This can only point to an efficient disease cleansing action on a population or community level under extensive free-ranging conditions, but which can be broken down by artificial and essentially intensive conditions as posed by captivity.

Acknowledgements

The authors wish to thank the National Parks Board for the opportunity to do this study; the Director, Veterinary Services, for permission to publish this paper; Dr. C. M. Cameron of the Veterinary Research Institute, Onderstepoort, for his co-operation and advice in the final identification and typing of bacterial isolates, and Mr. F. J. van der Walt for invaluable assistance during capturing procedures.

REFERENCES

- BABOONS IN ORGAN TRANSPLANTATION RESEARCH. 1968. Collected papers from a symposium held on 22 and 23 March 1968 as an interim report on the work done in a research programme jointly sponsored by the

- Faculty of Medicine of the University of Stellenbosch and the John Hopkins Hospital. Suppl. to the *S.A. Med. J.* 17 Aug. 1968.
- BAILEY, W. R. and E. G. SCOTT. 1966. *Diagnostic microbiology*. Saint Louis: C. V. Mosby Co.
- BOLWIG, N. 1959. A study of the behaviour of the chacma baboon, *Papio ursinus*. *Behaviour* 14: 136-163.
- BREDE, H. D. and G. P. MURPHY. 1968. Bacteriological aspects of renal allotransplantation or homo-transplantation. In "Baboons in organ transplantation research". Suppl. to the *S.A. Med. J.* 17 Aug. 83-87.
- BROOM, J. C. 1959. Leptospirosis. In "Infectious diseases of animals." Diseases due to bacteria. Vol. I. Ed. Stableforth, A. W. and I. A. Galloway. London: Butterworths Scientific Publications.
- CARPENTER, K. P. 1968. Some diseases of animals communicable to man in Britain. Proc. of a symposium, London, 1966. Ed. Graham-Jones, O. Oxford: Pergamon Press.
- CARPENTER, K. P. and E. R. W. COOKE. 1965. An attempt to find shigellae in wild primates. *J. Comp. Pathol.* 75: 201-204.
- DE VOS, V. and C. A. W. J. VAN NIEKERK. 1969. Brucellosis in the Kruger National Park. *J.S. Afr. vet. med. Ass.* 40: 331-334.
- FIENNES, R. N. T.-W.- 1972. Tuberculosis. In "Pathology of simian primates." Part II. Ed. Fiennes, R. N. T.-W.- Basle: S. Karger.
- FIENNES, R. N. T.-W.-, MARY PINKERTON and E. K. DZHIBIDZE. 1972. Enteropathogenic organisms. In "Pathology of simian primates." Part II. Ed. Fiennes, R. N. T.-W.- Basle: S. Karger.
- GOOD, R. C., B. D. MAY and T. KAWATOMARI. 1969. Enteric pathogens in monkeys. *J. Bacteriol.* 97 (3): 1048-1055.
- GROENEWALD, J. H. 1970. A review of the experimental projects supported by the University of Stellenbosch primate colony. *J.S. Afr. vet. med. Ass.* 41: 167-170.
- HENNING, M. W. 1956. *Animal diseases in South Africa*. Johannesburg: C.N.A.
- KALTER, S. S., R. E. KUNTZ, Y. AL-DOORY and A. A. KATZBERG. 1967. Collection of biomedical study materials from baboons in East Africa: Preliminary report. *Lab. anim. Care* 16: 161-177.
- KALTER, S. S., R. E. KUNTZ, B. J. MYERS, A. K. EUGSTER, A. R. RODRIQUES, M. BENKE and G. V. KALTER. 1968. The collection of biomedical specimens from baboons (*Papio* sp.). Kenya. *Primates* 9: 121-139.
- McCONNELL, E. E., P. A. BASSON, V. DE VOS, B. J. MYERS and R. E. KUNTZ. *In press*. A survey of diseases among 100 free-ranging baboons (*Papio ursinus*) from the Kruger National Park. *Onderstepoort J. vet. Res.*
- MINETTE, H. P. 1966. Leptospirosis in primates other than man. *Amer. J. trop. Med. Hyg.* 15: 190-198.
- NATH, M. L., J. B. SHRIVASTAV, S. K. SETHI and J. SINGH. 1966. *Salmonella* pattern in India. *Indian J. med. Res.* 54: 512-516.
- NIEBERLE, K. 1932. Tuberkulose bei Tier. *Ergeben. allg. Path. path. Anat.* 25: 631.
- PANDA, G. K. and S. P. GUPTA. 1964. *Shigella* serotypes in Uttar Pradesh. *Indian J. med. Res.* 52: 235-240.
- PINKERTON, M. E. 1967. Bacteremia in wild baboons. *Bact. Proc.* 67: 67.

- PINKERTON, MARY. 1972. Spirocheta, Spirillum, Leptospira. In "*Pathology of simian primates*", Part II, Ed. Fiennes, R. N. T.-W., Sydney: S. Karger.
- RANKIN, J. D. and A. McDIARMID, A. 1963. Mycobacterial infections in free-living wild animals. *Symp. zool. Soc. Lond.* 24: 119-131.
- ROTH, E. E. 1970. Leptospirosis. In "*Infectious diseases of wild mammals*", Ed. Davis, J. W., L. H. Kaestli, and D. O. Trainer, Ames: Iowa State University Press.
- RUCH, T. C. 1959. *Diseases of laboratory primates*. London: Saunders.
- SCHNEIDER, N. J., E. C. PRATHER, A. L. LEWIS, J. E. SCATTERDAY and A. V. HARDY. 1960. Enteric bacteriological studies in a large colony of primates. *Ann. N.Y. Acad. Sci.* 85: 935-941.
- SHILLING, G. W. 1961. *The Baboon: An annotated bibliography with added materials, 1607-1961*. The Southwest Foundation for Research and Education, San Antonio, Texas.
- STOLTZ, L. P. and G. S. SAAYMAN. 1970. Ecology and behaviour of baboons in the Northern Transvaal. *Ann. Transv. Mus.* 26: 99-143.
- URBAIN, A. 1941. Tuberculosis in captive monkeys. *Bull. Acad. Med.* 124: 281.
- VAGTBORG, H. 1965. The baboon in medical research. Proceedings of the First International Symposium on the baboon and its use as an experimental animal. Austin: University of Texas Press.
- VAN DER HOEDEN, J. 1964. Leptospirosis. In "*Zoonoses*", Ed. van der Hoeden J. Amsterdam: Elsevier Publishing Company.
- WOLFF, J. W. 1954. *The laboratory diagnosis of leptospirosis*. Springfield: Thomas